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ABSTRACT

In Kentucky, high stakes assessment of schools and school districts resulting from the state's educational reform initiative raises the issue of fairness. Should educational officials and teachers be held accountable for student performance despite vast differences in the socioeconomic conditions of the surrounding communities when extensive research shows community context affects student performance to a substantial degree? In this paper, a method is presented for assessing educational performance that corrects for community contextual factors. The issues of high stakes accountability and effective schools research are also discussed. The method relies on spatial analysis, a technique developed by geographers that entails mapping the standardized residuals from a regression analysis to find county school districts in which student performance is greater than expected, and less than expected, net of community context. Use of this procedure, it is argued, lessens possible bias in the Kentucky assessment results and helps allay concerns over unfairness in the state's accountability system. The procedure can be modified for a school-to-school analysis, although the mapping task would be more exacting in its smaller scale. Analysis of such spatial maps will allow educators to locate pockets of excellence and begin action research to identify particularly effective practices. An appendix discusses community level socioeconomic variables. (Contains 1 figure, 1 table, and 39 references.) (Author/SLD)

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Spatial Analysis of Kentucky Assessment Results, Social and Economic Indicators

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Abstract

In Kentucky, high stakes assessment of schools and school districts resulting from the state's educational reform initiative raises the issue of fairness. Should educational officials and teachers be held accountable for student performance despite vast differences in the socioeconomic conditions of the surrounding communities when extensive research shows community context affects student performance to a substantial degree? In this paper, we present a method for assessing educational performance that corrects for community contextual factors. The issues of high stakes accountability and effective schools research are also discussed.

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Spatial Analysis of Kentucky Assessment Results, Social and Economic Indicators

In Kentucky, high stakes assessment of schools and school districts resulting from the state's educational reform initiative raises the issue of fairness. Should educational officials and teachers be held accountable for student performance when the socioeconomic circumstances of school districts vary so much? Is not educational achievement affected by the socioeconomic environment of the surrounding community? An extensive body of research buttresses this concern by showing that community socioeconomic context--factors over which local educators have little direct control-- affect school climate and student performance to a substantial degree (Berliner & Biddle, 1995, Biddle, 1997; Bracey, 1997; Coleman, 1988, 1990; Coleman & Hoffer, 1987; Crane, 1991; DeYoung, 1991; Garner & Raudenbush, 1991; Guskey and Kifer, 1990; Hanushek, 1997; Lee, Smith & Croninger, 1997; Marino, 1995; Paul, 1996; Schneider & Coleman, 1993; Smith, Beaulieu & Israel 1992; Wenglinsky, 1997).

In this paper we present a method for assessing educational performance that corrects for community contextual factors. We also demonstrate the use of spatial analysis, a technique crafted by geographers, showing how it can contribute to a better understanding of the Kentucky assessment results. The spatial analysis technique entails mapping the standardized residuals from a regression analysis to find county school districts in which student performance is greater than expected and less than expected, net of community context. Use of this procedure, we argue, will lessen possible bias in the Kentucky assessment results and thus will help to allay the concern over unfairness in the state's accountability system.

The approach of this paper spotlights performance differences among Kentucky school

districts, but we will also suggest how to compare the assessment results of individual schools using a simple modification of the method shown here. The technique also permits the assessment of improvement or decline in school and school district performance.

High Stakes Assessment and Accountability

Education reform is not new. The 1970s saw the basic skills movement and minimum competency testing. The 1980s moved from expanded state mandates to reforming local school governance, as in site-based management (Cibulka & Derlin, 1995). A review of the literature on school improvement will identify the 1990s as the decade of school accountability (Sewall, 1996). Accountability is the generic term used to imply that teachers, administrators, schools, and school districts must answer to the public regarding the performance of their students (Bernauer & Cress, 1997; Wolf, LeMahieu & Eresh, 1992). It is based on the proposition that if the state and federal governments are going to pump significant dollars into school districts they have a legitimate interest in seeing that the districts use these public funds to achieve the educational goals the state and federal governments want. Accountability is also based on the belief that once educational goals are clearly articulated, they can be measured with the ultimate goal of tying educational funding to the performance results (Cibulka & Derlin, 1995). Most often, accountability takes the form of assessments administered to students. It may also consist of assessment information combined with various performance measures such as attendance, dropout, and retention rates.

There is no real consensus on the issue of efficacy of educational accountability programs. Most agree that the ultimate goal is the improvement of student learning. However, there is much debate regarding the type (standardized tests vs. performance measures) and setting (locally controlled vs. state developed and mandated) of the accountability assessments. Some educators

state that in order to be most effective, state and/or national assessments need to reflect the educational standards that the local community deems important (Bernauer & Cress, 1997; Lieberman & Miller, 1990). In fact, Theodore Sizer and his colleagues state that the proper locus for accountability is the local school (Sizer, McDonald & Rogers, 1993). Due to the premise that what is tested becomes what is taught (Resnick, 1993), these educators are now proposing that the best assessments reflect what the local community wants students to learn and are designed by local educators to demonstrate authentic learning (Smith, 1996; Wiggins, 1992). Additionally, they believe local educators must be personally invested in the standards and assessment if it is to effect any lasting change (Resnick, 1993). However, some educational reformers question the desirability of further standard setting and testing and debate both the efficacy and appropriateness of high stakes accountability testing (Cibulka & Derlin, 1995; Sizer, McDonald & Rogers, 1993).

External assessments of accountability, in contrast, do not reflect locally agreed upon curricular goals or standards. Educators in favor of local placement of accountability efforts believe external assessments cause a stagnation of the curriculum by encouraging teachers and administrators to focus more time and resources on test-taking and less on what has been locally defined as important (Herman, 1992). Some educators argue for local development and local control while other educational reformers advocate the development and use of better batteries of tests to externally monitor schools and learning (Macpherson, 1995). In fact, some educators believe it is absolutely necessary to change the modes of assessment in order to change the schools (Smith, 1996).

Despite concerns of appropriateness, accountability assessments are increasingly being

used as a means to facilitate school improvement (Cibulka & Derlin, 1995). Accountability measures are considered "high stakes" when significant rewards or sanctions result from high or low student performance, respectively. The rewards or sanctions can be leveled at the students, resulting in promotion/graduation or retention, or the rewards can be leveled at the school or district in various ways. Schools or districts might be deregulated by having highly restrictive state or federal guidelines waived for outstanding student performance, or be compelled to submit laborious records of attempts to improve performance if students score below the acceptable level. A more recent approach to high stakes accountability involves rewarding and sanctioning teachers and administrators in schools dependent upon student performance. Pay for performance is based on successful private sector practices that reward team members for outstanding production (Kirst & Odden, 1993). An example of using accountability programs as a punitive means of control is reported by Smith (1996) who states that some vocal groups in Arizona decided the problem with their schools was lazy and incompetent teachers who needed to have their feet held to the fire through a state-mandated accountability assessment program.

The Kentucky Education Reform Act (KERA) of 1990 implemented, among numerous and vast systemic educational changes, a primarily performance-based form of statewide student assessment: the Kentucky Instructional Results Information System (KIRIS). KIRIS was developed to provide the yardstick for determining whether the mandated KERA changes were effective. It consists of a combination of written examinations, portfolios, and performance events (which have now been omitted) administered to students at grades 4,5,7,8,11 and 12. It also includes school performance measures such attendance, dropout, and retention rates and the successful transition to adult life (indicated by enrollment in post-secondary training, the military

or employment) for graduating high school students. The KIRIS program is a very high stakes accountability system. Teachers in schools which surpass their expected school improvement scores are given significant monetary rewards. Schools which fail to reach their target scores are initially sanctioned through the mandatory development of educational improvement plans. Continued or severe lack of attainment of target performance scores leads to state assignment of a "distinguished educator" to lead the school improvement process and a resulting waiver of teacher and administrator tenure with possible job loss (Guskey, 1994).

Effective Schools Research

Educators are in the third decade of "effective schools" research to try to identify and clarify the within-school, within school district, and community demographic factors which affect student academic achievement. This research is commonly thought to have begun with the Equality of Educational Opportunity report which proposed that socioeconomic factors have a major impact on student achievement (Coleman, Campbell, Hobson, McPartland, Mood, & Weinfeld, 1966). Most of the research has explored factors within schools where student achievement is higher than would be predicted from the socioeconomic level of the school clientele and has been carried out in urban schools with high percentages of students from low income families (Creemers, Reynolds & Swint, 1996; Lezotte, 1994; Wimpleberg, Teddlie & Stringfield, 1989; Zigarelli, 1996). The effective schools literature is very sparse on the topic of how education in rural settings is impacted by the socioeconomic conditions of the community it serves. The present study, by looking at an entire state, focuses on both rural and urban education. Methodology already exists to identify pockets of excellence and pockets of poor academic performance controlled for the impact of socioeconomic factors. However, the

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procedures and results are not "user friendly" for most public school educators. The mapping techniques identified in this study present a way for educators without strong research backgrounds and the general public to interpret test score distributions across a state.

A Spatial Analysis of the Kentucky Assessment Results

Kentucky has 120 county school districts and 56 independent school districts. The independent districts are enclaves within certain counties and typically center on a distinctive community. In the multiple regression analyses that follow we will first look at contextual effects on the independent districts combined with the county districts; then we will analyze each subgroup. The spatial analysis, however, will only be done for the county school districts because we cannot easily represent the independent school districts on a state map.

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The Kentucky Department of Education uses 2-year weighted mean KIRIS scores in determining school and district performance. The 2-year weighted mean smooths interannual fluctuations that can be caused by variations in student body composition. Thus, this summary statistic is a more stable indicator of student performance than the single-year mean. For the present study we used the 2-year weighted mean scores from 1992-93 and 1993-94 as the dependent variable.

Our independent variables measure community socioeconomic context. We wanted to find local community factors that significantly correlate with the school district KIRIS score because such variables may indicate contextual influences on the KIRIS scores. When we correct for the effects of these community influences, the result will be a truer picture of how the school system itself supports student performance.

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Using the National Center for Educational Statistics School District Data Book (CD-ROM) for Kentucky and information provided by the Kentucky Department of Education, we considered a variety of variables that were potentially correlated with the district KIRIS score (see Appendix). In the end we selected two independent variables that in various multiple regression models were significant and substantively strong. These variables are: (1) median household income (in 1990) and (2) percent of high school graduates attending college (in 1991). Each variable represents major dimensions of community resources that can affect student performance. Median household income, for instance, is a measure of the financial resources within the school district. Yet it also probably measures other things. Income level captures consumer tastes that are locally prevalent, leisure-time activities, social and political awareness, and a broad array of other characteristics that closely associate with income. The percent of high school graduates attending college is related to income (for the independent and county district combined sample, r = .30; for the county district sample, r = .50). Yet it is also a distinct dimension in some contexts as we will see. This variable measures the total capacity of the local community for producing high school graduates who then sought a post-secondary education. Although this measure may also indicate the quality of the local school system, we propose that it is a broader indicator of the entire community's educational support capacity. In addition, this variables gives a baseline indicator of this capacity in 1991, when KERA was first promulgated to the school districts.

Analysis and Results

The analysis goes forward in two stages. First, we will perform multiple regression analysis on the combined sample of independent and county school districts and then will do similar analyses on the independent and county school districts taken separately. Second, we will

map the standardized residuals obtained from the regression model for the county districts.

Multiple Regression

Table 1 shows three multiple regression models. In the first model (the combined sample), we see that both median household income and percent high school graduates attending college are very significant and predict 46 percent of the KIRIS score variance. The model for the sample of independent districts has an even better fit, predicting 57 percent of the variance. As might be expected, the model for the county districts, since it analyzes a larger sample than the independent districts, predicts less variance (40 percent). Still, this is impressive. All these models confirm that community context substantially influences average student performance. The results shown in Model 3 are especially interesting. Median household income is strong and very significant in this model but high school graduates attending college is nonsignificant. For Kentucky county school districts the financial resources of the local population is such a key contextual factor that dominates college attendance and other factors. We tried, for example, entering other variables with median household income in the regression model for the county district sample. Income dominated these other variables as well.[1] But because college attendance was important in the other two regression models shown in Table 1, we have kept this variable in the analysis of the county district sample.

We can get an idea of the magnitude of the contextual effects on the KIRIS scores by looking at the unstandardized regression coefficients in Table 1. The unstandardized coefficients in all three models show that a $10,000 increase in median family income increases the KIRIS score an average of more than 3 points. The effect is greatest for the county districts where the average increase reaches a high of 3.5 points. A 10 percent increase in college attendance is

associated with an average increase in the KIRIS score of just over 1 point for the combined sample and nearly 2 points for the independent districts but has no effect on the county district scores. Why this difference exists between the independent and county school districts is beyond the scope of the present paper but is an issue that warrants future investigation. However, it is likely related to the tendency for the independent districts to be either "highly desirable" schools which tend to draw the better students from the county school system or to be considered very undesirable schools with a high percentage of at-risk and impoverished students.

Spatial Analysis[2]

From the third model in Table 1 we obtained the standardized residuals and then categorized them into five levels. The levels capture the expected level of student performance by school district after we have subtracted the average effects of income and college attendance.

Standardized residual	**Expected level of student performance**
-3.0 to -1.5	Much worse than expected
-1.5 to -.5	Somewhat worse than expected
-.5 to .5	About as expected
.5 to 1.5	Somewhat better than expected
1.5 to 3.0	Much better than expected

A more conservative breakdown of categories would be: -3.0 to -2.0, -2.0 to -1.0, -1.0 to 1.0, 1.0 to 2.0, 2.0 to 3.0. Using this stricter approach reduces the number of 'much worse than expected' school districts from eight to three. A similar reduction in the number of 'much better

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than expected' school districts would also occur. Since the cut points for the categories are arbitrary, the final determination of the categories must await further experience with using the technique. Our purpose here is only to demonstrate the technique's possibilities.

The categorization scheme is used to show county school district performance on a map of Kentucky. The map reveals that when we subtract the effects of income and college attendance most of the county school districts in the central and western parts of the state are performing about as expected. Many school districts in the southeast, however, perform worse than expected. This is noteworthy. These school districts are located in the region having the lowest incomes and college attendance rates in the state. But since we have controlled for these contextual factors, the result suggests other deficiencies in this region. To draw conclusions about whether these deficiencies are intrinsic to the region's school systems or are due to other, still unidentified community factors would be premature. Nevertheless, since the income variable appears to powerfully represent outside-school influences, it is hard to escape the suspicion that some deficiencies lie in the education process per se in these largely rural school districts. A second, smaller pocket of less than expected performance is found centered around Nicholas County. This is another largely rural area. But rural areas are not the only ones where student performances are less than expected. Three county school districts near Ashland, five districts in northern Kentucky near Cincinnati, and three districts near Louisville perform less well than expected. It may be that both ruralness as well as urbanicity are disadvantageous contexts as far as student achievement is concerned. The map hints at this conclusion but a more detailed study must be done before we can say this with confidence.[3]

County school districts performing at better than expected levels are more evenly

distributed across the state than districts performing at less than expected levels. This suggests to us that the better than expected cases are more likely the result of unique circumstances within the school districts. With few exceptions (these being Lexington-Fayette County, Oldham County, and Greenup County), none of the better than expected school districts is found inside a metropolitan area and some are quite rural. Since the effects of income level and college attendance have been corrected, we suggest that the districts performing at better than expected levels had on average better prepared students and the strongest schools in 1992 to 1994.

Discussion and Conclusion

The procedure described above can be modified for a school-to-school analysis. This analysis is more difficult than the one we have shown using school districts because the contextual factors that impact a single school are hard to isolate. Nevertheless, the problem is not insurmountable. We might substitute the percent of students on free or reduced lunch program for median family income. This would give us a measure of the general income level of the families who send children to that school. To establish a baseline of the school's educational capacity at the outset of KERA, we might use the percent of students promoted to the next grade level (or 12th graders graduating from high school). The multiple regression model would then be run with these independent variables. After obtaining the residuals, schools could grouped into categories as was done for the county districts. Schools performing better or worse than expected could then be identified. The school residuals could also be mapped. However, this mapping task would be more exacting than the county district mapping since a smaller scale map is required. Geographers regularly draw such maps using either street addresses or geographic coordinates to fix locations. The methodology is already worked out, and software exists to

expedite some of the more laborious steps.

To assess improvements and declines in either school or school district scores involves another simple modification of the study used in this paper. KIRIS scores that are weighted means can be compared. The increase or decrease in a school's or a district's weighted mean scores is calculated as the simple difference between KIRIS scores at the later point and the earlier point in time. We then let this difference be the independent variable. The analysis is unchanged. Since the Kentucky Department of Education uses such differences in weighted mean scores to determine a school's eligibility for rewards (or sanctions), we would like to see if the kind of analysis we have proposed here would change the assessment results. We hope to conduct such an analysis in the coming months.

Further, by providing a way for educators to identify pockets of excellence, the effective schools research can expand into more rural and suburban areas. Analysis of the spatial map presented here will allow educators to locate pockets of excellence and begin action research projects to identify particularly effective practices for specific types of educational community settings.

Assuming that states will want to continue, or even increase, accountability assessments of schools due to the large investment of state dollars the real issue is how to conduct assessments with externally imposed norms so that they are accurate and fair. The techniques employed to make the process fair must also be understandable by school personnel and the general public. The technique presented here represents both a fair and understandable analysis to help ensure that schools and districts are not held accountable for factors over which they have no control, e.g., parental income levels. By subtracting the effects of local context, we get a fairer and more

accurate assessment of how closely a school district approximates externally imposed standards.

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Appendix

Before doing the multiple regression analyses we explored a number of community level socioeconomic variables that are potentially associated with district KIRIS scores.

Variable	Correlation w/KIRIS scores
Median household income	.605
Percent high school graduates attending college	.516
Average age of the population	.128
Educational inequality within the population	-.405
Income inequality	-.248
Racial heterogeneity	.046
Total number of households	-.013

As shown, the KIRIS scores are more highly correlated with income and college attendance than with any other variables we have examined so far.

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Notes

1 Guskey and Kifer (1990) obtained strikingly similar results using pre-KERA (1987) normed basic skills test scores for Kentucky school districts. For some corroborating evidence that uses KIRIS scores from schools in Lexington-Fayette County, see the Lexington Herald-Leader feature article by Krista Paul (1996).

2 We would like to thank Tim Pitts, Assistant Professor of Geography at Morehead State University, for showing us how to map residuals and Karen Helton, an undergraduate geography student, for producing the map.

3 Regression analyses done too late to be incorporated in this paper suggest that this is indeed the case.

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STANDARDIZED RESIDUALS

Model = KIRIS Score = f(Income, College Attendance)

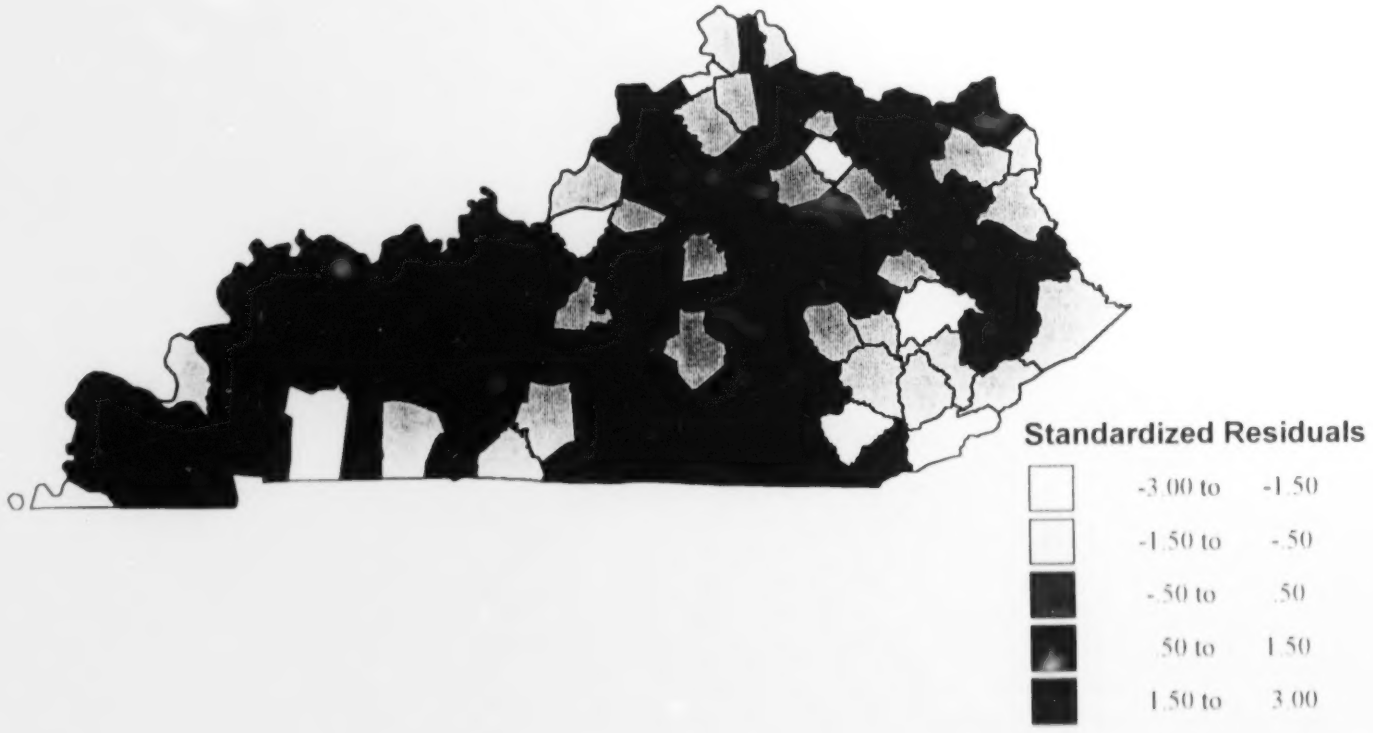

Table 1. Unstandardized Regression Coefficients: Mean KIRIS Scores as a Function of Income and College Attendance*

Independent variable	Model 1 Independent & county districts	2 Independent only	3 County only
Median HH income	3.139E-04 (9.236)	3.388E-04 (6.262)	3.527E-04 (8.283)
% HS grad attending college	.107 (5.537)	.181 (5.187)	-2.246E-02 (-.912)
Adj R^2	.455	.565	.403
N	176	56	120

*t-ratios in parenthesis